Texas Commission on Environmental Quality

INTEROFFICE MEMORANDUM

To: **Jackie Hardee** **Date: May 5, 2003**
Director, Remediation Division
Office of Permitting, Remediation, and Registration

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Subject: **Calculation of a Tier 2 Residential Soil PCL for Arsenic under TRRP for the USEPA El Paso County Metals Site Response Action**

Summary:

USEPA is the lead agency in a response action to address unacceptable levels of arsenic and lead in soils within certain residential yards in El Paso (El Paso County Metals Site). As part of these efforts, USEPA commissioned a study to evaluate the bioavailability of arsenic in soils from the El Paso remediation area (lead was not addressed as part of this study). TCEQ Toxicology & Risk Assessment staff have reviewed these results and have incorporated them in the calculation of a Tier 2 site-specific protective concentration level (PCL) for arsenic in residential soil under the guidelines of the Texas Risk Reduction Program (TRRP). This Tier 2 soil PCL includes the exposure pathways that are combined in the $^{Tot}Soil_{Comb}$ expression (soil ingestion, dermal contact, inhalation, and ingestion of homegrown vegetables). The bioavailability adjustment affected the soil ingestion pathway (refinement to the assumed relative bioavailability factor, RBAF). In addition, given the site-specific nature of arsenic uptake into vegetables, Tier 2 refinement of the vegetable ingestion pathway was conducted (assumed soil-to-above ground plant biotransfer factor, Br_{Abg}). The potential for contaminant migration to groundwater, ecological risks, or other relevant pathways were not specifically addressed in this assessment.

A Tier 2 soil PCL ($^{Tot}Soil_{Comb}$) for arsenic of **46 mg/kg** was calculated following these site-specific adjustments. Refer to TRRP (Figures 30 TAC §350.74(a) and §350.75(b)(1)) for default assumptions, equations, and other technical detail related to the calculation of a residential soil PCL for arsenic. Supporting information for the Tier 2 changes is briefly discussed in the following sections.

Soil Ingestion Pathway:

USEPA contracted with scientists from the College of Veterinary Medicine at the University of Missouri, Columbia to assess the relative bioavailability of arsenic in soil samples taken from El Paso. Two representative arsenic-containing soil samples were fed to juvenile swine to assess the bioavailability of arsenic in soil relative to soluble arsenic (the form of arsenic relevant to the critical studies upon which the toxicity factors for arsenic in TRRP are based). The bioavailability for the two soil samples were 37% and 44% relative to soluble arsenic. Since there did not appear to be a scientific rationale for exclusively utilizing results from one soil

sample or the other, an average relative bioavailability of 40% was selected (an approach that is also consistent with the reasonable maximum exposure approach taken in TRRP). This site-specific value was utilized in place of the TRRP Tier 1 default relative bioavailability factor (78%).

Ingestion of Homegrown Vegetables:

In assessing soil-to-plant transfers, certain site-specific considerations can significantly alter the appropriate soil PCL. TRRP requires that a soil-to-plant biotransfer factor be applied to model the transfer of arsenic from soil into above and below-ground vegetables. This factor varies based on soil conditions that influence the availability of arsenic for plant uptake (e.g., soil pH). It is important to note that the same factors that limited the oral availability of arsenic in soils (40% relative availability as described above) are likely to be somewhat applicable to the availability of arsenic to plants, although it is not possible to easily apply this bioavailability data quantitatively for this pathway.

In selecting a soil-to-plant uptake factor, it is critical to recognize that uptake rates differ among the various types of crops that might be grown in a home garden. This variability is especially pronounced with above-ground vegetables, due to the wide variety of vegetable types that are represented in this group (e.g., leafy vegetables, garden fruits, legumes). Leafy vegetables (e.g., lettuce) tend to have the greatest potential to accumulate arsenic. Toxicology & Risk Assessment staff contacted the El Paso County Extension Service for information about the types of vegetables most often grown in that area. Extension Service staff stated that the climate tended to limit extensive reliance on home gardens, but that tomatoes, peppers, and fruit trees were probably the most likely crops to be grown if gardens were present. These experts did not believe there was significant potential for extensive amounts of homegrown leafy vegetables.

The default Tier 1 above-ground soil-to-plant uptake factor for arsenic is heavily weighted toward leafy vegetables. Given local gardening habits in the El Paso area, a soil-to-above-ground plant uptake factor (Br_{Abg} of 0.002) that is more representative of uptake into the types of above-ground vegetables likely grown and consumed in home gardens in El Paso (e.g., tomatoes, garden fruits, peppers) was utilized in calculating a Tier 2 soil PCL for this pathway. This value is approximately five fold lower than the default Tier 1 soil-to-above-ground plant uptake factor in TRRP.

Tier 2 PCL determination:

Table 1 provides the individual pathway-specific soil PCLs after incorporation of these specific Tier 2 refinements for arsenic. Combining these individual pathways results in a Tier 2 soil PCL of 64 mg/kg based on carcinogenic effects and **46 mg/kg** based on non-carcinogenic effects. The lower of these values is applied as the final Tier 2 $^{Tot}Soil_{Comb}$ PCL for arsenic.

If you have questions regarding this evaluation, please feel free to contact me at (512) 239-1572.

Table 1: Individual pathway-specific soil PCLs following Tier 2 adjustments for arsenic.		
Carcinogenic Effects	Soil Ingestion	100 mg/kg
	Dermal Contact	460 mg/kg
	Inhalation (0.5 acre)	5300 mg/kg
	Vegetable Ingestion	310 mg/kg
Non-Carcinogenic Effects	Soil Ingestion	61 mg/kg
	Dermal Contact	360 mg/kg
	Inhalation (0.5 acre)	Not Applicable
	Vegetable Ingestion	370 mg/kg